Diagnosis of Snoring and Obstructive Sleep Apnea: A Review of the Accuracy

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Introduction

Snoring is common in the adult population, and it is associated with varying levels of upper airway resistance. Sleep may not be interrupted at lower levels of airway resistance; but with increased resistance, transient arousals from sleep will occur because of the effort required to maintain ventilation. This is known as upper airways resistance syndrome (UARS). With further increases in resistance, patients may experience episodes of hypoventilation and oxygen desaturation, known as obstructive sleep apnea (OSA)-hypopnea syndrome.1

The 2006 Canadian guidelines for the diagnosis of sleep-disordered breathing in adults define the severity of OSA using the apnea and hypopnea index.2 Apnea is defined as an event that lasts 10 seconds or longer; and is a reduction in airflow (nasal pressure or respiratory inductance) greater than 50% from baseline, or a reduction in airflow less than 50% accompanied by arousal or oxygen desaturation of 4% or more. Hypopnea has been defined as an abnormal respiratory event lasting at least 10 seconds with at least 4% oxygen desaturation, and with a minimum reduction in airflow or thoracoabdominal movement of 30%. Mild OSA is five to 15 events of apnea or hypopnea per hour of sleep, moderate OSA is classified as 15 to 30 events per hour; and severe disease is more than 30 events per hour.2

OSA is more common in those who snore; in men; and in patients with obesity, hypertension, and physical abnormalities of the upper airways.3 The definition of primary snoring specifically excludes symptoms associated with OSA and UARS, including sleep disruption, insomnia, and daytime sleepiness. However, it is difficult to differentiate between primary snoring and OSA from clinical symptoms alone. A diagnosis of snoring is made when OSA and UARS are ruled out.1

The 2006 Canadian guidelines for the diagnosis of sleep-disordered breathing in adults state that laboratory polysomnography (PSG) is the accepted standard for the evaluation and diagnosis of OSA.2 However, PSG has limitations, as it requires experienced personnel to evaluate the results, it is not readily available to all patients, and the testing itself can be expensive.3,4 Most countries can meet approximately 10% of the demand for PSG testing in patients with suspected OSA.5 Portable monitors to diagnose OSA may be less expensive and more readily accessible alternatives to PSG, and they can be used in the home.4 However, the ability of the monitors to diagnose OSA is highly variable.1

Oral appliances are being used more frequently for treatment of patients with OSA.6 Radiologic imaging techniques, such as cephalometric x-rays, computed tomography, and magnetic resonance imaging, have been used to assess airway anatomy differences in patients with OSA and other sleep-disordered breathing (not including snoring). Some of these imaging techniques have also been used for the assessment of oral appliances for the treatment of OSA.7

Objective

The objective of the report is to answer the following research questions:

- What is the accuracy and reliability of devices for diagnosis of snoring and do they accurately rule out obstructive sleep apnea?
- What is the evidence that imaging techniques are necessary for diagnosis of snoring or obstructive sleep apnea or before treatment with an oral appliance following diagnosis?
Methods

A limited literature search was conducted on key health technology assessment resources, including PubMed, The Cochrane Library (Issue 1, 2008), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI, EuroScan, and international health technology agencies. A focused Internet search was also conducted. Results included articles published between 2004 and March 2009 and were limited to English language publications. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, and guidelines.

Results

The literature search identified two meta-analyses and two evidence-based guidelines. Obstructive sleep apnea carries a high risk of perioperative morbidity and mortality. Polysomnography is recommended by the American Society of Anesthesiologists for preoperative screening when indicated, but it is not always possible. Anesthetists, therefore, require screening tests to rule out OSA in patients with a low-risk of the syndrome. A meta-analysis was performed on preoperative screening tests for OSA. Two independent researchers reviewed articles from 1966 to 2008 that measured the diagnostic value of overnight PSG versus questionnaires, clinical models (history and physical exam with or without other measurements or investigations), and prediction equations (regression equations or algorithms). The investigators excluded studies that did not use overnight monitored PSG as the reference standard and that did not provide prevalence of OSA information with raw data in 2 x 2 tables or did not provide sensitivity and specificity or positive or negative likelihood ratios. The authors also excluded studies that did not have a complete description of the clinical methods; however, this was not clearly defined in the meta-analysis.

There were 26 studies in the final analysis, including eight questionnaires and 18 clinical prediction tests (algorithms, regression models, and neural networks). Each test was evaluated for the frequency of true- or false-positive or negative diagnoses. From this data, the tests were assigned a diagnostic odds ratio (DOR), based on their specificity and sensitivity. The false-negative (FN) rate was calculated as one minus the sensitivity. Tests with a DOR of 10 to 80 were classified as good, those greater than 81 were rated as excellent, and an ideal test had a DOR greater than 81 and an FN rate of zero.

The results of the analysis showed that no single questionnaire or clinical model met all the criteria for the ideal preoperative screening tool. The most accurate tools were the Berlin and sleep disorders questionnaires, the Kushida index (morphometry), and the Battagel combined clinical-cephalometry model. However, the authors proposed that because of the high degree of heterogeneity and FN rates, a significant proportion of patients with OSA would be missed by all questionnaires and most clinical models. For example, although the Berlin questionnaire was the most accurate with FN rates ranging from 14.5 to 38.2, it would not be able to conclusively rule out OSA preoperatively. As well, the accuracy of these tests was not readily reproduced in multiple validation studies. Limitations of this meta-analysis include an unclear definition for the clinical methods exclusion criteria and the significant heterogeneity between studies included in the analysis.

Ghegan et al. performed a meta-analysis of studies comparing portable (home) sleep monitors with laboratory PSG for the evaluation of OSA. The primary objective was the difference in the respiratory disturbance index, with the null hypothesis that there would be no difference between the two methods. Secondary objectives included a comparison of the mean low oxygen saturation levels, recorded sleep time, percentage of inadequate studies, and cost. The investigators included studies that had simultaneous or sequential portable monitoring and PSG, and also included one of the secondary outcome parameters.

The authors included 18 studies in their analysis, including the Watch_PAT and Apnoescreen-II.
For the respiratory disturbance index, pooled data on 12 studies demonstrated that the portable monitors were 10% lower on average than with lab PSG tests. Combined data of three studies revealed no significant difference for the mean low oxygen saturation levels between portable and laboratory PSG monitoring. In five studies, the laboratory sleep times were on average 13% longer compared with home studies. There was a significant degree of heterogeneity between studies for average sleep time. A cost comparison from four countries showed that portable sleep monitors were 35% to 88% less than laboratory studies.4

The authors concluded that home sleep monitors may underestimate the severity of sleep apnea, although the lower costs make them useful screening tools for OSA.4

The 2006 Canadian guidelines for the diagnosis of sleep-disordered breathing in adults categorize complete laboratory PSG as level I for diagnostic procedures and assigned it a level of evidence of C (case control or cohort studies with a risk of bias). Portable monitoring devices are classified as level III sleep studies and are useful for improving access to diagnosis of sleep-disordered breathing (level C evidence). Portable monitoring devices can also be used to confirm OSA diagnosis in patients with a moderate to high pretest probability of the illness, but they have limited use with other forms of sleep-disordered breathing and comorbid illnesses (level C evidence).2

These findings are aligned with the American Academy of Sleep Medicine guidelines. In 2007, the Academy issued guidelines for the use of portable monitors in the diagnosis of OSA. The guidelines state that lab PSG monitoring is the standard of practice for the diagnosis of OSA. They indicate that portable monitors should only be used for the diagnosis of OSA in conjunction with a comprehensive sleep evaluation by a certified sleep practitioner. The guidelines also state that portable monitors may be used as an alternative to PSG only in patients with a high pretest probability of moderate-to-severe OSA and that they are not appropriate for patients with significant comorbid illnesses (e.g., congestive heart failure).9

The 2006 Canadian guidelines state that clinical predication formulas can be used to assess the probability of sleep-disordered breathing and to prioritize patients for further evaluation, but are insufficient to establish a diagnosis (level C evidence).2

The Canadian Thoracic Society 2006 sleep-disordered breathing guidelines for adults state that oral appliances are an appropriate first-line treatment for patients with mild-to-moderate OSA who have minimal daytime symptoms (level A evidence — high-quality meta-analysis or single randomized controlled trial with a low risk of bias). The guidelines recommend follow-up treatment to ensure the effectiveness of the appliance, but they do not make any recommendations for the use of imaging techniques.2

In 2005, The American Academy of Sleep Medicine issued practice parameters for the treatment of snoring and OSA with oral appliances. The guidelines state that cephalometric evaluation is not always necessary for patients who are prescribed an appliance. They recommend that patients undergo PSG testing or attend a cardiorespiratory sleep study after the appliance has been fitted. The guidelines did not make any recommendations for the use of other imaging techniques.6

Limitations

There is a paucity of evidence-based data for the diagnosis of snoring and OSA, and for the use of radiological imaging techniques for OSA diagnosis and oral appliances fittings. There are no current evidence-based studies, analyses, or guidelines for the diagnosis of primary snoring. There is one meta-analysis that reviews portable monitors compared with PSG and one meta-analysis for preoperative screening tools. The available literature on radiological imaging was limited. The Canadian guidelines do offer levels of evidence ratings for their recommendations, but the American guidelines do not.
Conclusions

There is a lack of evidence-based articles for the diagnosis of primary snoring; therefore, the included studies primarily focus on devices used for the diagnosis of OSA (the diagnosis of primary snoring is made when OSA is excluded). Both the American and Canadian guidelines state that PSG is the gold standard for the diagnosis of OSA. Portable monitoring devices should be used only in patients with a moderate-to-high probability of the syndrome and who do not have any severe comorbid illnesses. The meta-analysis by Ghegan et al. also concluded that portable monitoring devices may underestimate the severity of sleep apnea. Therefore, portable devices should only be used to screen snoring patients who are very likely to have OSA, and the diagnosis of OSA should be confirmed with PSG monitoring.

The routine use of radiologic imaging techniques for use in the diagnosis of OSA or when fitting oral appliances is not supported by Canadian or American guidelines. Further information is required regarding the use of imaging techniques in the diagnosis of OSA. Additional research is required to develop monitoring devices or screening tools that will accurately rule out OSA in patients who snore.

References


